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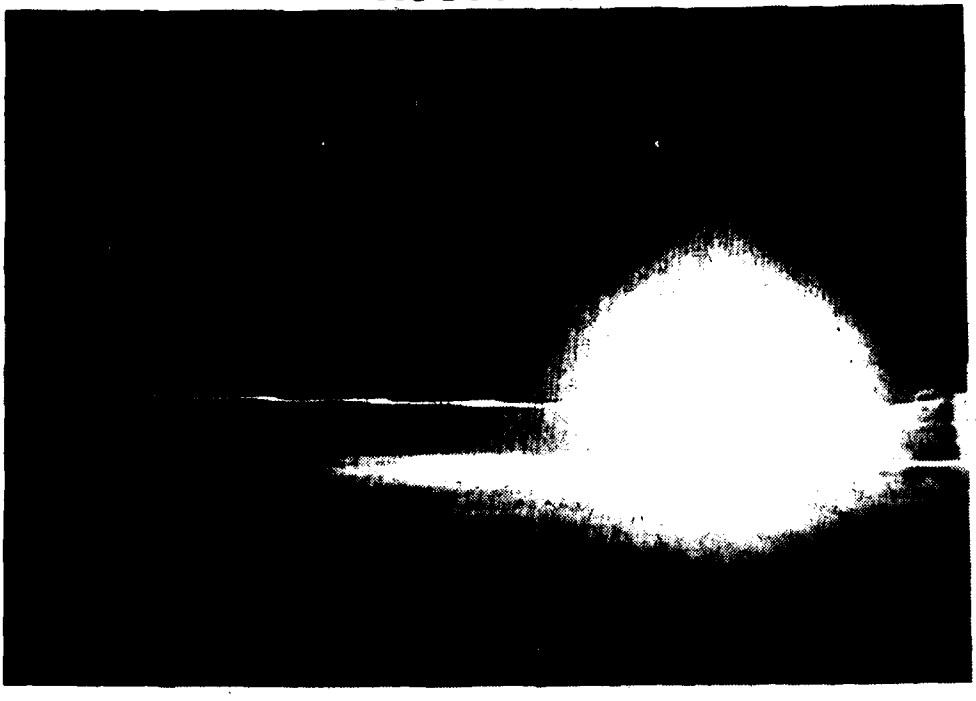
FINAL REPORT

MAIN TANK GUN SIMULATOR PROGRAM

AUGUST 1994



PREPARED FOR:

CAMOUFLAGE RESEARCH TEAM
VISIONICS, IMAGE AND SIGNAL PROCESSING DIVISION

12 pg

NIGHT VISION DIRECTORATE
US ARMY CECOM RD&E CENTER
FORT BELVOIR VA. 22060-5606

FINAL REPORT

MAIN TANK GUN SIMULATOR PROGRAM

AUGUST 1994

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TABLE OF CONTENTS

1. **INTRODUCTION** There is a need in the United States Army for a flash simulation device which replicates the signature from a main gun of an M1 Abrams Main Battle Tank when being fired. This is essential because current training simulators do not adequately simulate a live fire and would be ineffective in a combat situation. This device is needed to enhance deception operations and can be used as a stand alone device or in conjunction with tactical vehicle decoys (see figure 1).

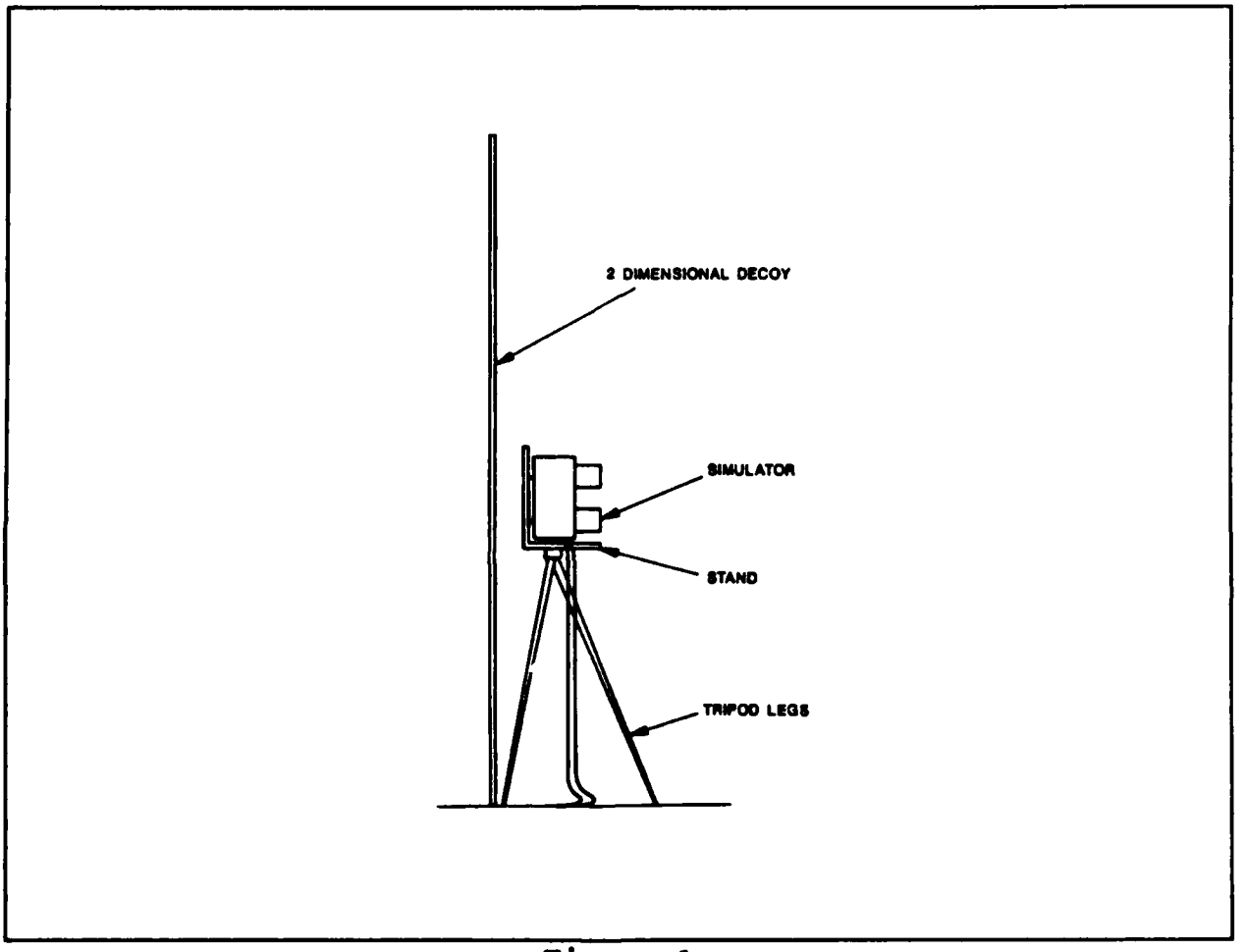

Figure 1

The US Army CECOM Research, Development and Engineering Center (CRDEC) has conducted a market survey for existing commercial systems following the Non Developmental Item (NDI) approach.

The main effort of the Camouflage Research Team, Night Vision Directorate, consisted of finding potential sources and contacting manufacturers of flash simulation type devices. This approach encompassed a product search for off the shelf technologies which were applicable to requirements given in the Mission Needs Statement (MNS). This was done by placing an announcement in the

Commerce Business Daily (CBD) the week of 24 July 1992; a publication called Shotgun News with worldwide distribution and by contacting several companies who were involved in similar type programs.

2. **BACKGROUND** The program has been in the concept development stage since FY'90. In the past, several types of rounds already in existence have been used in military training exercises with unacceptable results. The data collected from the participants in these exercises shows that the size of the flash and smoke signature provided by these rounds was insufficient to replicate the signature of an actual tank firing.

Belvoir's efforts were NDI in nature and are in keeping with Department of Defense Acquisition Management Policies and Procedures. (DOD Directive 5000.1 and DOD Instruction 5000.2, part 6, section L.)

3. **PURPOSE** The purpose of Belvoir's effort in the Main Tank Gun Simulator Program was to demonstrate that viable technologies are currently available in the commercial marketplace that are capable of replicating the signature of a live round. These simulators must meet or exceed the requirements which were assigned by measuring the signatures from an actual tank firing. These measurements are listed below and were given as parameters which should be met.

Flash Color	IAW FED-STD 595a 22510
Smoke Color	IAW FED-STD 595a 36628
Flash Intensity	100 ft-candles @ 200 ft perpendicular to muzzle (or flash origination)
Duration (Flash)	96.6 milliseconds
Smoke Signature	To commence 1/2 time period through flash life, or 48 milliseconds after flash commencement
Size (Flash and Smoke)	
Length	30 to 40 ft.
Diameter	20 ft.
Shape	Cylindrical
Infrared (IR)	Detectable difference between ambient temperature (at any time between 25 and 85 degrees F.) and flash temperature.

4. DISCUSSION The Main Tank Gun Simulator market research procedure consisted of locating existing firms to find potential suppliers of the simulator system or a system that could be easily adapted to meet the requirements outlined. Potential candidates were reached through a variety of means which will be discussed in paragraph 5. Once contact was made with the potential suppliers, a packet of information including all of the required operational characteristics was sent to them. This packet of information included the requirements listed above, a Reliability, Availability and Maintainability (RAM) questionnaire and a safety questionnaire to address certain safety concerns with potential systems.

Also addressed in the announcement and through further conversations with potential suppliers was the fact that the flash and smoke were not necessarily required to be produced by means of pyrotechnics. Any method which could potentially provide a system which fulfilled the requirements would be evaluated.

5. DATA COLLECTION METHODS AND SOURCES Identifying and locating manufacturers which were both interested and capable of participating in the flash simulator program was accomplished through several methods.

5.1 COMMERCIAL ADVERTISEMENT An advertisement was placed in Shotgun news. This periodical is published by Snell Publications of Hastings Nebraska. The publication carries similar advertisements from major weapons and pyrotechnic manufacturers. No companies responded through this method however.

5.2 COMMERCE BUSINESS DAILY An announcement was placed in the Commerce Business Daily (CBD) on 24 July 1992 by the Concepts And Development Team. This advertisement ran for a period of one week. The majority of respondees to this program were contacted through this method.

5.3 COMMON PROGRAM CONTACTS Several companies were contacted who had participated in similar type programs such as the Extended Range Countermine Grapnel (ERCG) and the Small Projected Line Charge (SAPLIC) and have experience in these types of areas.

6. ANALYSIS AND CANDIDATE SUMMARY A number of companies stated that they would be able to produce the type of simulator required using different means ranging from a strobe light and smoke to a gas propellent type device. In the end, only pyrotechnic type devices were submitted for testing. None of the companies who submitted ideas for other types of systems were able to provide a device which would have fit into the size restraints given that calls for a one man portable system. Each candidate system was evaluated to determine the ability to perform to the required parameters which were given in the CBD announcement and in the follow on correspondence. These requirements were given values and used as a base for evaluation as indicated. The candidate systems

which did not meet the correct size parameters or withdrew were not rated using this system.

6.1 ACCEPTED CANDIDATES The following companies were evaluated as possible candidates:

RTF INDUSTRIES INC.	WOERNER ENGINEERING
TITAN DYNAMICS	MARTIN MARIETTA
ELMHURST RESEARCH	NEW ENGLAND ORDNANCE
E.C. CORPORATION	MGI
PAINS WESSEX	MK BALLISTIC

6.2 UNACCEPTED CANDIDATES The following companies were not accepted as possible candidates or withdrew from consideration.

TVI	GENERAL SCIENCES INC
CW CURTIS	GEN CORP/AEROJET
BATTELLE	MM WAVE TECHNOLOGY
NICO PYROTECHNIK	ALLIED RESEARCH
BEI DEFENSE SYSTEMS	HECHLER AND KOCH
ISP INC	MK BALLISTIC SYSTEMS
BOURBON STREET ASSOC.	PYROTECHNICS LACROIX (USA) INC
NKF ENGINEERING	DEFTEC
BRUNSWICK DEFENSE	PAINS WESSEX SCHERMULY

APPLIED ORDNANCE TECHNOLOGY

7. **FINAL CANDIDATES** After evaluation, five (5) systems were chosen for testing. Included in the following list are the final five candidates which were tested at Aberdeen Proving Grounds MD.

WOERNER ENGINEERING MARTIN MARIETTA

RTF INDUSTRIES TITAN DYNAMICS NEW ENGLAND ORDNANCE

8. **ABERDEEN PROVING GROUNDS TESTING** Testing of the simulators was conducted by TECOM at APG in October of 1993 on the five systems. These results are documented in the Abbreviated Test Report written by TECOM and distribution is limited to Government Agencies only. However, during testing it was discovered that none of the simulators performed to the standards given, that meaning that they all failed in at least one required area, so a decision was made to go to the manufacturers and request a second generation simulator which would perform more closely to the standards.

9. **SECOND GENERATION SIMULATORS** The second generation simulators were tested at FT. A.P. Hill Va. during July of 1994. During this test it was discovered that there was a significant improvement in the performance of the simulators. From these tests it was concluded that all of the candidates provided a simulator which performed to the required standards.

10. **REMOTE FIRING CAPABILITIES** Also investigated during this effort was the capability of remotely firing the devices. These devices were either loaned to the Concepts and Development Team for testing purposes or procured from companies who showed an interest in this portion of the program. These companies were:

Magnavox HDS Inc. Caswell International Corp.

These devices allow a single operator to set up a number of flash simulators with receivers and remotely detonate them in any order they choose dependent on the tactical situation, or the transmitter can be pre-programmed to run a particular scenario. Distances ranged from 2 to 4 kilometers line of sight from transmitter to receiver (see figure 2).

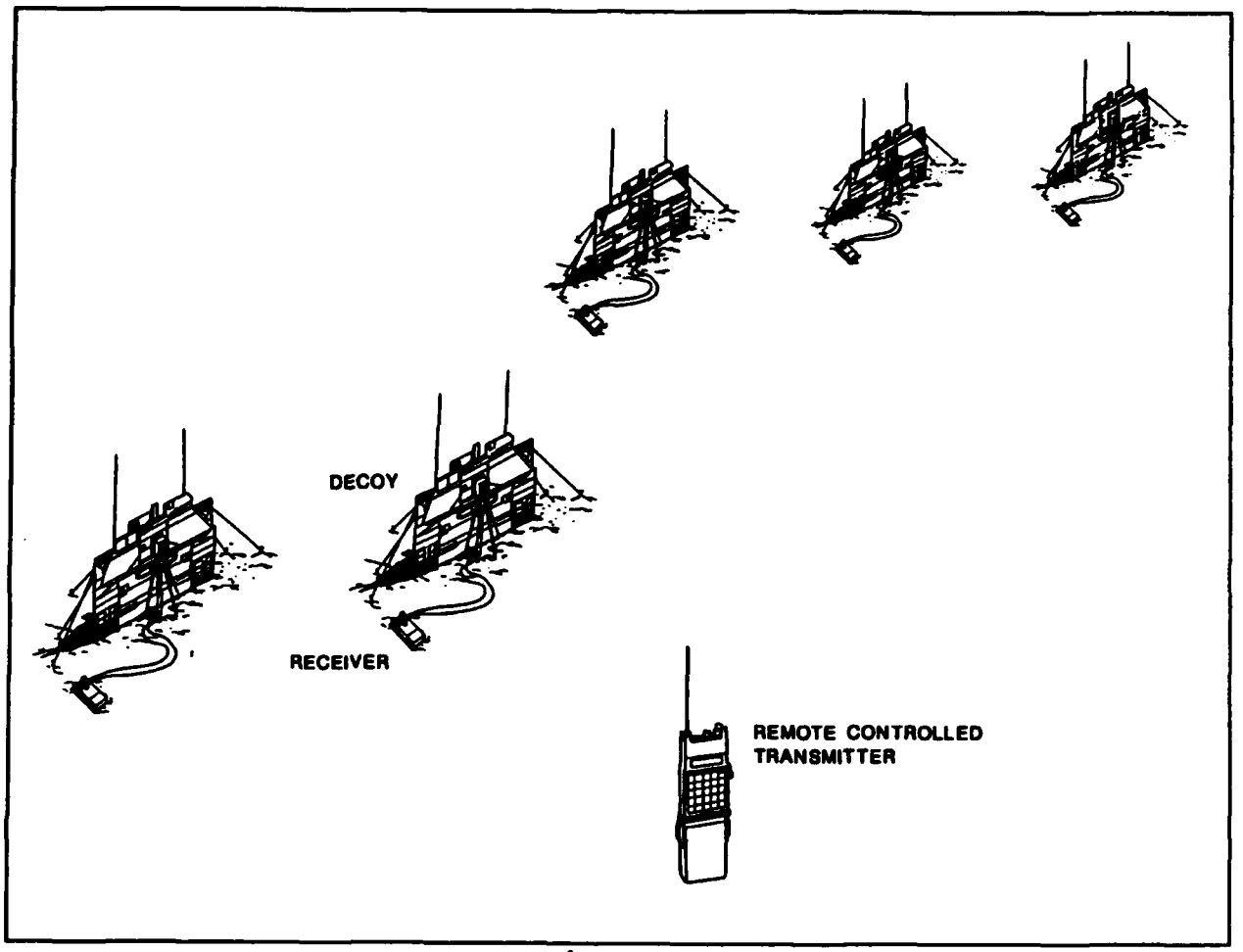

Figure 2

The device which showed the most promise is already type classified and is currently being procured by the Department of Defense.

The remote firing capability can be especially useful in a tactical situation for many reasons. The simulator, along with the two dimensional-thermal image decoys, can be set up in tactical scenarios such as being integrated into an armored defensive perimeter (see figure 3).

Once the flash simulator is activated, it draws the opposing forces' attention towards the flash, thus causing him to divert his attention to the deception and away from the actual tanks. This in turn provokes the OPFOR to expose his location when he begins to maneuver towards the deception operation and to expend crucial ammunition towards an expendable decoy.

Figure 3

Another scenario which can be portrayed is the use of the flash simulator deployed in a defensive perimeter on an enemy avenue of approach, with a live armored platoon set up under cover in a flanking position. Once the OPFOR is within the maximum effective range of the main gun of the particular decoy you are using, the simulator would then be activated remotely, drawing their attention. Upon being alerted to the deception they would begin maneuvering towards it, thereby exposing their flanks to the real tanks.

11. CONCLUSIONS AND RECOMMENDATIONS With the support and input from the many pyrotechnic experts who were consulted during this project, and the results from the flash simulator tests, we feel confident in saying that the technology to provide a flash simulator to replicate the main gun firing of an M1 tank is readily available in the industry. These devices are designed for safe handling and will not expose the troops to any toxic elements. They are also designed to be set off remotely from great distances which allows both an additional safety factor and the obvious benefit of

being far enough away from the deception when the enemy begins to maneuver towards it.

In conclusion, it is felt that a complete Main Tank Gun Simulator, including flash simulator and remote firing device (which is already type classified and in the supply system), can be fielded using the Non Developmental Item approach thereby proving this Market Survey to be successful.